EUGENE WASHBURN ROARK

L. R. Jones and G. W. Keitt

Eugene Washburn Roark was born at Lexington, Ky., Sept. 5, 1894, and died at Minneapolis, Minn., Oct. 14, 1918. He spent his early youth at Lexington, where his father occupied the chair of education in the University of Kentucky. He received his early education in the schools of Lexington and Richmond, from which he went to Clark College, where he was granted the degree of Bachelor of Arts in 1914. Throughout his undergraduate training he continued to develop the naturalistic bent of his earlier youth and turned to the biological courses in anticipation of later specializing in plant pathology. In 1914 he entered the University of Wisconsin as a graduate student in plant pathology. His first research work comprised a very creditable study of certain aspects of the relations of *Phytophthora infestans* to the potato and the tomato. The results of these studies were presented as a thesis for the degree of Master of Science in 1915. From 1915 to 1917 he served as assistant in the Department of Plant Pathology and in 1918 he was awarded a fellowship in this department. Throughout this period, he rendered faithful services of the highest quality, particularly in relation to the fruit disease courses and investigations of the department. At the same time, he prosecuted his own studies and research work with vigor and success.

The entrance of the United States into the war brought responsibilities which Roark met unflinchingly, and in the fulfillment of which he later gave his life. While awaiting his call to the colors, he carried the entire burden of the fruit disease work of the department, in the absence of the other members of that section of the staff, and at the same time completed the work for his doctorate, which was conferred in June, 1918. His doctor's thesis was a highly creditable dissertation on "The Septoria Leaf Spot of Rubus." On Sept. 3, before he had been able to finish preparing his thesis for publication, he responded to his call to the colors and entered the Naval Aviation Service at Minneapolis. After a brief period of training, he contracted influenza which rapidly developed into pneumonia, to which he succumbed on Oct. 14, 1918.

Dr. Roark combined in a rare way the characteristics of the sincere friend, the courteous gentleman and the scholarly scientist. The keen sense of personal loss on the part of his university associates is tempered only by the realization that he entered his country's service with deliberation and devotion, ready to give without stint of his splendid young manhood, and it remains their privilege thus to continue to share in some small degree in his supreme sacrifice.

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THE SEPTORIA LEAF SPOT OF RUBUS

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The fungus formerly known as *Septoria rubi* Westendorp causes leaf spots on many species of Rubus (blackberries and raspberries) and attacks the stems of some of these species. The disease occurs throughout Europe and North America. In the United States it has been reported from all but seven states, and is present in all sections where the hosts are grown to any considerable extent.

Wherever found, it is usually quite common but rarely serious. It cannot be considered a major disease of bramble fruits. The chief damage done is brought about by early defoliation, which inhibits normal bud development and predisposes the canes to winter injury.

The leaf spots vary in appearance on different hosts but at maturity usually show light colored centers with brownish or reddish borders. The pathogene also causes inconspicuous lesions on the petioles and canes of some hosts.

The leaf spot fungus was named *Septoria rubi* by Westendorp about 1850. This name was antedated by the possible synonyms, *Ascochyta rubi* Laschin 1832 and *Ascochyta ruborum* Libert in 1834, but as the identity of the forms thus named has not been definitely proved, it seems advisable, for the present, to retain Westendorp as authority for the species name.

The ascigerous stage, first found in 1917 in Wisconsin, is a species of Mycosphaerella which in its morphology does not agree with any published descriptions of fungi occurring on Rubus. It seems necessary, therefore, to describe it as a new species.

Proof of the relation between the imperfect and the perfect form is based on: 1. constant association of the two in the locality where peri-

[1] When Dr. Roark responded to his call to military service, he had completed the preliminary draft of his doctor's dissertation and had prepared an abstract which was filed with the university authorities for publication in the event of his being unable to complete the preparation of his paper. The fuller paper was so nearly ready for release and was so meritorious that publication of this abstract has been postponed in the hope that the original paper might yet be edited and published. This has not been feasible, due to the fact that the plates and certain other important sections of the paper have not been found since Dr. Roark's death. It is supposed that, working under extreme pressure, he took some of his material with him for the final touches when he went into the service, and that due to his sudden and untimely death, he was unable to leave the necessary directions for its disposition. Under these circumstances, his abstract is being published, and the available parts of the original paper are being placed on file in the university library.—G. W. Keitt.

thecia have been found, 2. cellular connection of perithecia and pycnidia on the same dead leaf; 3. similar behavior of ascospores and pycnospores in germination, and similarity of the two in pure culture; 4. positive results from inoculations with spores from the ascigerous stage.

Pycnidia formed in spots on green leaves vary from typically well formed pycnidia to thin walled, imperfectly formed fruiting bodies which approach the acervulus in structure. Pycnidia formed on dead leaves are thick walled, closely grouped, and arise from heavy stromateoid masses of mycelium. It has seemed best in the discussion of these pycnidial forms to designate them, respectively, as summer pycnidia and winter pycnidia.

After a study of perithecia from the different hosts the perfect stage is described as follows:

Mycosphaerella rubi n. sp. Perithecia mainly hypophyllous, sometimes amphigenous, usually gregarious, erumpent, globose, 60–80μ in transverse diameter with a short papilliform ostiole, black, walls pseudoparenchymatous, two or three cell layers thick, aparaphysate; asci subclavate to cylindrical, eight-spored, very short pedicellate, 42–45 by 8–10μ in water; ascospores hyaline, slenderly fusiform, of two equal cells, straight or slightly curved, very slightly constricted at septum, 20–25 by 3.50–4.25μ, extreme limits in length 17–28μ, sometimes tending to occur in fours in the ascus, usually irregularly biseriate. Conidial stage: *Septoria rubi* Westendorp. Hab. on fallen leaves of *Rubus strigosus, R. parviflorus, R. allegheniensis* and *R. hispidus* in Door County, Wisconsin.

In studies of the germination of pycnospores and ascospores it was found that they readily germinate in water and nutrient solutions and that pycnospores reflect strain differences in their variable behavior in germination. Some pycnospores and ascospores have shown a definite reaction to strong, diffused sunlight, the developing germ tubes exhibiting negative heliotropism.

The minimal temperature for germination in water or in a favorable nutritive medium is slightly below 2° C.; the optimal, between 18° and 26°, about 23°; and the maximal, about 32° or slightly above.

About fifty strains of the fungus have been carried in pure culture, isolations having been made at different times of the year from the leaves and canes of various host species. Strains from the same or different hosts varied considerably in regard to type and amount of spore production, and in stromatic development, some readily forming pycnidia, while others formed only masses of needle-shaped secondary conidia. When grown on about thirty media, the fungus showed only minor variations, except that Lima bean agar was found to favor the production of secondary conidia even in case the fungus was usually stromatic.

The minimal temperature for growth on a nutrient substratum, potato agar, is less than 2°C., the optimal, between 20° and 23°; and the maximal, about 32°.

It is believed that the production of secondary conidia is primarily a strain characteristic varying greatly with different strains, but that within a given strain it can be encouraged to a certain extent by crowding of spores at the time of germination, frequent transferring, use of special media, and optimal temperature for growth.

The stromateoid type of pure-culture growth will live for several months at room temperature (about 22° to 25°C.); but, at the same temperature, cultures consisting of masses of secondary conidia lose their viability within about two weeks.

The results of many inoculations with spores derived from both pycnidia and perithecia may be briefly stated as follows: 1. spores from the ascigerous stage were found to produce leaf infection, resulting in lesions which sometimes contained typical pycnidia but usually imperfectly formed fruiting bodies; 2. the stem form of the fungus was proved to be identical with the leaf form; 3. blackberry strains would not cross to raspberries, nor would the raspberry strains infect blackberries. Conclusions were drawn from no inoculations except those which were adequately controlled by uninoculated plants and from which successful reisolations were made.

The fungus commonly overwinters as mycelium and immature pycnidia in dead leaves and, in the case of red raspberries, in the bark on canes. Perithecia are a factor in the overwintering, but are restricted in occurrence.

In Wisconsin, leaf spots usually begin to appear two or three weeks after the leaves are well opened and continue to increase in number until frost, the amount of infection depending primarily upon weather conditions.

Primary infection is brought about mainly by newly formed pycnospores from overwintering pycnidia on dead leaves or bark, though ascospores may also function in this way. Secondary infection throughout the season is caused by pycnospores from the current-season lesions.

Mature ascospores can be found late in May, and continue to develop well into July—occurring most abundantly during June. Pycnidia are formed in practically all lesions, their frequency depending somewhat upon the host variety. Viable pycnospores can be found throughout the year but are more abundant at certain times. This is due to the fact that there are usually so-called waves of infection which are correlated with periods of rainfall.

The period of incubation for the fungus in leaves was found to vary from 8 to 11 days in most inoculation experiments, although wider variations sometimes occurred. From observations it would seem that in nature the incubation period may show even greater variations.

Field infection is favored by moderately cool weather and frequent periods of rainfall.

As a result of observations and experiments, it is believed that the disease is spread into cultivated plantations primarily by diseased nursery stock, the fungus being carried in the bark or persistent leaves. The principal agents of spore dissemination are wind in case of the ascospores, which are forcibly discharged into the air, and splashing or wind-borne rain in case of pycnospores, which exude in masses and can be scattered only after being separated in water.

Among the host species and varieties observed by the writer, the dewberries and smooth-leafed blackberries have shown the greatest amount of spotting, while certain black raspberries and *R. odoratus* have been least affected. These differences have not been explained.

The following tentative suggestions for controlling the disease are based primarily upon the work of others, coupled with the writer's observational evidence.

1. Care should be taken to obtain disease-free plants for setting out new plantations.

2. Sources of inoculum should be reduced by destruction of dead leaves and old canes in the fall.

3. When conditions for the development of leaf spot are favorable, pray with Bordeaux mixture, 3–3–50, after the leaf buds are well opened, nd at intervals of two or three weeks until the fruit is two-thirds grown.

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